Crotalus oreganus concolor (Viperidae; Crotalinae): a Case of Envenomation with Venom Analysis from the Envenomating Snake: a Diagnostic Conundrum of Myo-neurological Symptoms

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Highlights

- Midget-faded rattlesnake envenomation is an uncommon occurrence.
- Myo-neurological symptoms may result from Midget-faded rattlesnake envenomation.
- Stress-induced physiological responses may result following a rattlesnake bite.
- Venom-induced and stress-induced effects may cause a diagnositic conundrum.
- Concolor presynaptic neurotoxin can cause myotoxic effects.

Abstract

Crotalus oreganus concolor is a small species of North American rattlesnake, indigenous to a confined middle region of the western United States. Reports of envenomation to humans are quite rare, and studies regarding the toxicity and pharmacological actions of *C. o. concolor* venom have shown the presence of a presynaptic PLA_2-based neurotoxin, low molecular weight myotoxins with myotoxic effects, and very low metalloproteinase (SVMP) activity. A case of envenomation that resulted in what appeared as potentially venom-induced myo-neurological symptoms is described. The patient sustained a single fang puncture from the bite of a captive *C. o. concolor* to the right thumb while pulling open a drawer-type housing unit to examine the snake. Shortly thereafter, while being transported via ambulance, the patient experienced blurry vision, total body paresthesia, dyspnea, chest tightness, and three waves of spastic muscle movements that involved the hands and feet, and appeared as tetanic-bursts. These symptoms had resolved spontaneously prior to arrival at the hospital. Local envenomation effects at the bite site were evidenced as swelling, mild ecchymosis, pain, and numbness of the thumb persisted for greater than a week. The observed paresthesia and tetanic-burst symptoms were confounding as to which were potentially venom-induced or were related to stress-induced physiological responses. The patient's laboratory values and coagulation parameters remained within normal limits, other than a slightly elevated D-dimer and moderately elevated creatine kinase. Coagulopathic symptoms or bleeding were not observed. Antivenom was not administered at any stage for various reasons and symptoms were successfully managed symptomatically. Venom from the offending snake was collected and venom analysis revealed the presence of high levels of myotoxins, small peptides that can induce rapid tetanic limb muscle contractions in mice, and myokymia or fasciculations in humans. Concolor toxin, a presynaptic neurotoxin that can cause respiratory paralysis and myotoxic effects, and several serine proteinases often associated with coagulopathies, were also present.

Key Words: Midget-Faded Rattlesnake, Crotalus oreganus concolor, envenomation, venom, myo-neurological

Introduction

The Midget-Faded Rattlesnake (*Crotalus oreganus concolor*) is a small (50-65 cm total body length) subspecies with a muted beige and tan color pattern that was originally assigned to the *Crotalus viridis* complex. Currently, it is recognized as a subspecies in the *Crotalus oreganus* clade (Ashton, 2001; Parker and Anderson, 2007). It is indigenous to a small geographic range of the Colorado Plateau that includes west-central Colorado (including the Colorado and Green river basins), eastern Utah, and southwestern Wyoming (Woodbury 1929, 1958). More recently, its range has been extended into extreme northern Arizona (Brennen, 2004).

Early studies of *C. o. concolor* venom revealed the presence of potent lethal Mojave toxin-like components, and it was found to be one of the most lethal crotaline venoms, nearly equal in toxicity to *Crotalus durissus terrificus* and *Crotalus scutulatus scutulatus* venoms, based on the results of murine lethality experiments (Glenn, 1977). An antigenically similar toxin to Mojave toxin has been isolated from *C. o. concolor* venom (Pool and Bieber 1980, Weinstein et al. 1985). Additionally, it has been reported that *C. o. concolor* venom lethality has ranged from 10-30 fold greater than that of *C. o. abyssus, C. o. caliginis, C. o. cerberus, C. o. helleri, C. o. lutosus, C. o. oreganus, C. v. nuntius,* and *C. v. viridis* (Glenn 1977; Mackessy et al., 2003). Presynaptic phospholipase A_2 beta neurotoxin (concolor toxin) and non-enzymatic peptide myotoxins have been identified as major venom components with potent lethal pharmacological activities (Mackessy et al., 2003; Mackessy, 2010; Modahl and Mackessy, 2016; Pool and Bieber, 1981).

Well-documented cases of human envenomation by *C. o. concolor* have rarely been reported, and fatalities are not found in the literature. Myotoxic and neurological symptoms have been reported in two cases, and involved ataxia, facial and perioral numbness, and numbness that radiated down through the torso (Mackessy et al., 2003). A single case has been reported in which there was myokymia (Lovecchio et al., 2005).

The case of envenomation from the bite of *C. o. concolor* reported here illustrates what clinically appeared to be potential venom-induced myo-neurological symptoms that were confounded by non-venom-induced effects related to hyperventilation and hypocalcemia. An analysis of the venom from the offending snake suggested a possible correlation between specific components in the venom profile and some of the observed clinical symptoms.

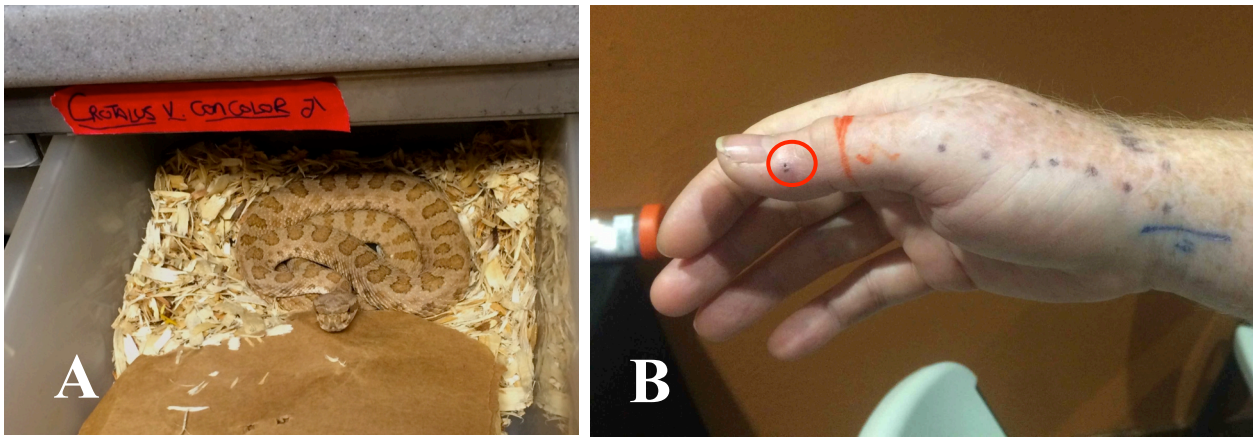
Case Report

An adult captive (wild caught - exact locality unknown) *C. o. concolor* (Fig. 1 A) inflicted a bite to a healthy 61-year-old Caucasian male, professional herpetologist. The patient had a history of prior crotaline envenomations: one *Crotalus horridus*, one *C. h. atricaudatus* (subspecies recognized at the time of the bite) and one *Crotalus durissus ruruima*), in addition to other envenomations that involved several other genera of venomous snakes (*Agkistrodon, Atractaspis, Naja, and Vipera*). These had also involved treatment with various antivenom products (Instituto Butantan Anticrotalico, Wyeth Anticrotalic (twice), and SAIMR Polyvalent),

with anaphylactic reactions following antivenom administration in three separate instances. Patient prescribed medication history included atenolol, rizatriptan as needed, and amitriptyline at night for migraine suppression.

The incident took place in a remote rural setting, and the bite having occurred when the snake was being removed from a drawer-type housing unit, with a single fang penetration into the distal phalangeal region of the right thumb (Fig. 1 B).

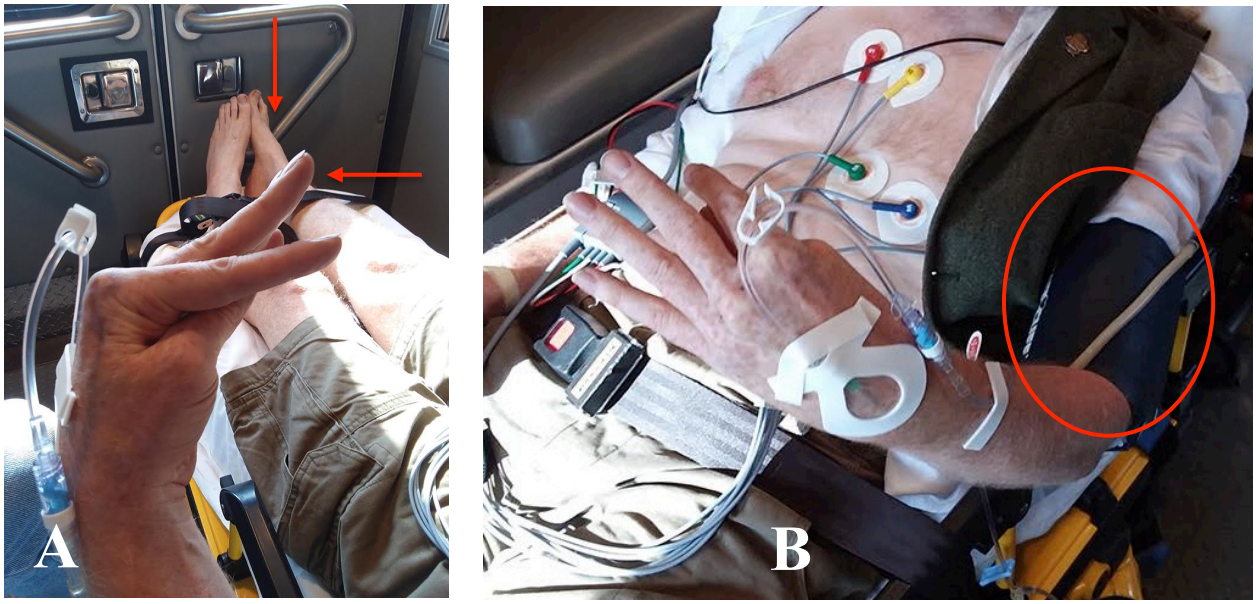
Fig 1. Panel A: The Midget Faded Rattlesnake (*Crotalus oreganus concolor*), responsible for the bite, in its housing drawer enclosure from which it struck, impaling a single fang puncture to the patient. Panel B: Single fang puncture into the distal phalangeal region of the right thumb.



Immediately following the bite, the patient experienced generalized "pins and needles" sensation in the bitten thumb, followed shortly by tingling of the lips, and reported feeling chest tightness. Within fifteen minutes the patient reported entire body tingling. The first responder found the patient supine on the cool concrete floor, and reported that the patient did not appear to be overly anxious or agitated. Respirations and pulse were normal to slow, and there were no obvious signs of hyperventilation. The patient described feeling like he was, "wearing a clay mask and a hat with hat band one size too small constricting around my forehead". The affected limb was splinted to maintain immobilization followed by a one-hour ground ambulance transport to the helispot, and a subsequent one-hour helicopter flight to a rural hospital. En route via ground ambulance transport the patient complained of breathing difficulty, and supplemental oxygen was provided via placement of a nasal cannula. Additionally, tightening of the tongue, blurred vision, and difficulty speaking were experienced by the patient. The paresthesias were accompanied by three separate waves of transient neuromuscular spasms that also appeared to affect both smooth and skeletal muscles (inspirational weakness). Spastic contractures of first the left hand, then on a second separate occasion the left hand again, and to lesser degree the right (bitten) hand and toes, followed by a third separate wave to the left forearm and lower leg. The first responder reported these as waves of severe spastic muscle movement that appeared to be tetany-like (Fig 2 A). These symptoms began approximately 30 minutes post bite, each episode lasted less than10 minutes, and they occurred approximately 20-30 minutes apart. The patient was alert and oriented, simultaneous hand and foot cramping were observed, with blood pressure and pulse normal to low by palpitation and sphygmomanometer/cuff (Fig 2 B). The patient

reported chest and head pressure with breathing difficulties, slight blurring of vision, local pain, and total body tingling.

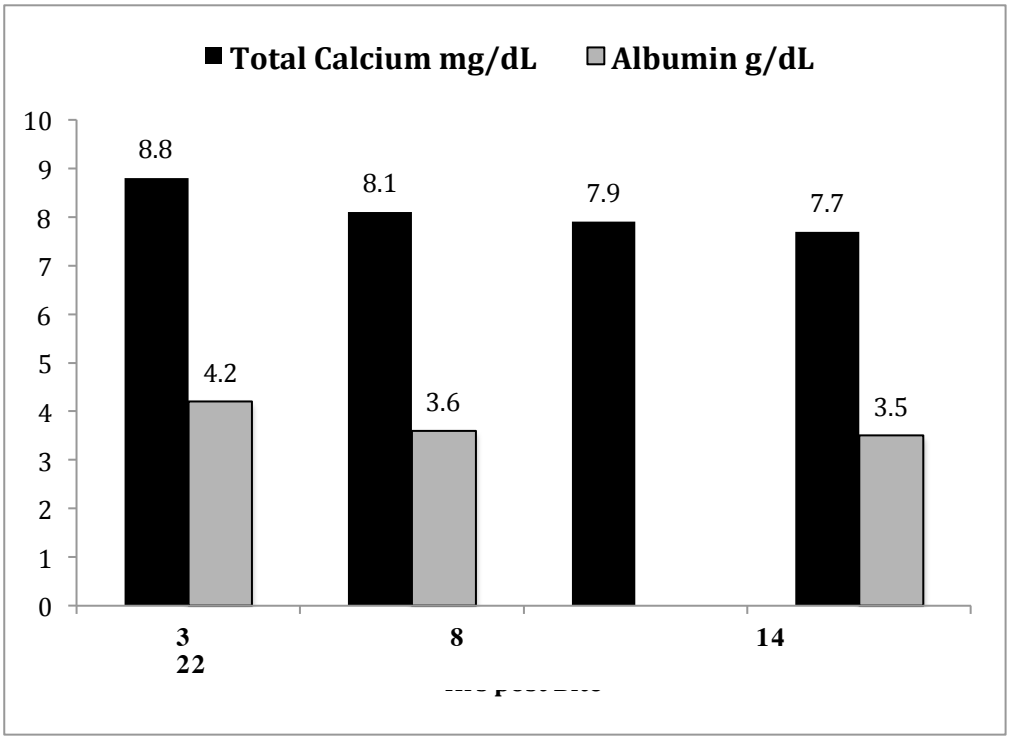
Fig 2. Panel A: Tetany-like spasms showing flexion of the hands and extenision of the feet (carpopedal spasms) that began 30 minutes post bite. Three waves of approximately 10 minutes each, 20 minutes apart, were observed. Panel B: Blood pressure and pulse were normal to low as measured by palpitation and the sphygmomanometer/cuff placed on the contralateral arm.



Three hours post bite the patient arrived in the emergency department. The apparent waves of myo- and neurological (hand and foot, upper and lower limb contractures and extensions) observed during transport were transient and had abated. Only a single fang puncture, with local swelling that extended proximally from the right thumb to the thenar eminence, was evident upon examination. Laboratory results for all parameters on admission were within normal limits excepting a slightly elevated D-dimer value of 566 ng/mL FEU (lab range 190-490 ng/mL FEU), and elevated creatine kinase (CK) value of 3394 U/L (lab range 22 to 198 U/L). Additionally, there was a gradual decline in total calcium from 8.8 mg/dL at admission (reporting laboratory range 8.5-10.1 mg/dL) to 8.1 (7.5 hrs), 7.9 (13.5 hrs), and 7.7 (22 hrs), with a corresponding decline in serum albumin from 4.2 g/dL at admission (reporting laboratory range 3.4-5.0 g/dL), to 3.6 g/dL (7.5 hrs), to 3.5 g/dL at 22 hrs (Fig. 3). Antivenom was not administered per the patient's request, and because his clinical symptoms appeared to have resolved. The swelling continued to spread proximally over the next few hours, reaching to mid-forearm at its furthest, but the local pain had lessened. However, the patient was observed to have considerable loss of total body strength, coordination was poor, and a Walker/Zimmer frame was required to stand. There was no evidence suggestive of compartment syndrome. The patient was observed for another 6 hours and discharged home at 25 hours post envenomation (22 hours post admission) in a stable condition. At 24 hours after discharge the patient was weak, but able to walk slowly without assistance. He continued to experience myalgias in the right arm and overall generalized weakness for the next few days. A few weeks later, sloughing of skin around the bite site was observed, but other than numbness of the thumb, all other local

symptoms had resolved completely. Laboratory studies on follow-up at three weeks were unremarkable.

Fig 3. Patient total serum albumin and calcium levels showing a gradual decline over the 24-hour interval following the bite.



Venom Analysis

Venom was extracted manually from the offending *C. o. concolor* approximately 4 days after the bite occurred, centrifuged to pellet cell debris and then lyophilized; the yield was approximately 120 µL, corresponding to approximately 27 mg dry venom. Venom solubilized in PBS at 8.0 mg/mL, and 200 µL (1.6 mg) was subjected to reversed phase high performance liquid chromatography (RP-HPLC) as reported previously (Smith and Mackessy, 2016); one-minute fractions were collected and lyophilized. Toxins were identified from the known elution profiles of purified toxins and quantified via peak area integration (% total area).

HPLC fractions were also subjected to polyacrylamide gel electrophoresis under reducing conditions (SDS-PAGE; Smith and Mackessy, 2016) to identify chromatogram peaks. Crude venom was assayed for protein content via Pierce® BCA assay (Smith et al., 1985) and then for six enzyme activities common to rattlesnake venoms (Mackessy, 2010). These data were used in conjunction with HPLC chromatogram data to identify protein families present and their relative abundance in the venom.

Results and Discussion

The case presented is perplexing in that it illustrates a diagnostic conundrum that clinicians can be faced with regarding the emergency medical management of a venomous

snakebite patient: what symptoms might be the result of venom-induced effects, and what symptoms might be related to other stress-induced physiological responses? Available detailed literature regarding envenomation by *C. o. concolor* is limited; however, symptoms previously reported following envenomation by this species reveal similarities and differences with those observed in the current case (Lovechio et al., 2005; Mackessy et al., 2003). *Crotalus o. concolor* venom has been shown to contain myotoxic and neurotoxic venom components, and envenomation is capable of eliciting neurotoxic symptoms (Mackessy, 2003, 2010; Modahl and Mackessy, 2016; Pool and Bieber, 1981). Thus, assessment of cause with respect to the observed symptoms in the presented case, combined with the interpretation of the analytical results of venom derived from the snake that inflicted the bite, provide for an interesting discussion.

The acuity and complexity of the symptoms experienced by our patient following the bite are confounding. Blurred vision, total body paresthesia, breathlessness and chest tightness, waves of spastic tetanic bursts of the hands with extension of the feet, and the generalized weakness with poor coordination suggests that they were symptomatic components potentially related to venom-induced systemic toxicity. Purified *C. o. concolor* venom toxins injected into mice have been reported to elicit myotoxic effects such as rapid ataxia and hind limb extension (Ownby et al., 1988). In contrast, some of these similar initial ensuing symptoms such as the patient's tetanic bursts, which could be described as carpopedal spasms, may not have been venom-induced, but rather have potentially resulted from patient anxiety-induced hyperventilation. These myoneurological symptoms could also have been triggered by sphygmomanometer cuff inflation (Mrunalini et al., 2014; Rehman and Wunder, 2011). Additionally, the symptoms of blurred vision, weakness, perioral paresthesia, and difficulty breathing have also been reported in other cases of North American rattlesnake envenomation, including *C. o. concolor* envenomation (Bush and Siedelburg, 1999; LoVecchio et al., 2005).

Venomous snakebite to a human is a serious medical event, and can trigger significant anxiety in the unfortunate victim. Consequently, the clinical presentation of neurotoxicity can be clouded and confounded by the emotional response of a snakebite victim. Anxiety can lead to patient hyperventilation-induced alkalemia (respiratory alkalosis) with consequent precipitation of hypocalcemia (Mrunalini et al., 2014). This condition can result in symptoms of breathlessness and paresthesia of the face and hands, while blood pressure remains normal. Tetany-like symptoms may be evidenced by painful sharp flexion of the wrist and ankle joints (carpopedal spasms), cramps, muscle twitching, and seizures with associated stridor, occurring in response to the hyperexcitability state of muscles and nerves due to decreased extracellular ionized calcium (Mrunalini et al., 2014). Although ionized calcium was not measured in the current case, the patient's total calcium declined within 24 hrs from 8.8 mg/dL to 7.7 mg/dL, and in parallel serum albumin declined from 4.2 g/dL to 3.5 g/dL, respectively (Fig. 3). Our patient was not observed to be hyperventilating as evidenced by tachypnea; however, hyperventilation may also occur via slow deep breathing, which is not always readily observable in emergent situations. Hypocalcemic tetany of the lower extremities has been reported in a case of *Crotalus scutulatus* envenomation, and with minimal coagulopathy. However, it was thought to have been subsequent to rhabdomyolysis (Bush and Jansen, 1995). Thus, an anxious snakebite victim may over ventilate to the point of respiratory alkalosis followed by hypocalcemic tetany, while maintaining a normal blood pressure. Several of the neurological symptoms observed in our patient fit the profile of these stress-related physiological responses, which cannot be ruled out as a contributing root of cause.

The monitoring of vital signs in venomous snakebite patients, specifically blood pressure measurements, often involves the use of a sphygmomanometer with an inflatable cuff. Our

patient had his blood pressure monitored during ambulance transport, and the question of whether or not the inflation of the cuff, in conjunction with hyperventilation-induced hypocalcemia, triggered a classic Trousseau sign also has to be considered (Rehman and Wunder, 2011). Cuff inflation to greater than the mean arterial pressure can result in the hand adopting a characterized posture of flexion of the metacarpophalangeal joints, with the interphalangeal joints of the fingers and thumb extended so that the thumb is in an opposing posture, as observed in our patient (Fig. 2B). This phenomenon has been reported to occur in 1-4% of healthy individuals (Habib and Wunder, 2014), and has not been reported to occur in cases of venomous snakebite. Again, the possibility of this observed symptom having been a stress-induced response rather than venom-induced must be considered.

In parallel to stress-induced symptoms, an evaluation of our patient's potentially venom-induced symptoms must be considered. It is possible that some of the myo-neurotoxic symptoms observed following the envenomation were experienced due to the confirmed presence of high myotoxin content in the venom of the *C. o. concolor* (Figs. 4, 5). The potent neurotoxin, concolor toxin, is known to be present in *C. o. concolor* venom, and the myotoxic components of *C.o. concolor* venom possess muscle contractile activity, causing rapid tetanic-like hind limb hyperextension in mice, a venom/toxin-induced symptom, which is similar to, and may be confused with, the symptoms observed in our patient as evidenced by the extension of the ankles, feet, and toes (Hayes and Bieber, 1986; Ownby et al., 1988). Additionally, the rapidity of death from respiratory failure observed in mice injected with *C. o. concolor* venom suggests the possibility that the patient could potentially have experienced "air hunger" from incipient respiratory distress, which fortunately did not progress to more serious respiratory compromise in our patient. Respiratory insufficiency in human rattlesnake bite victims has been reported to occur following *Crotalus scutulatus*, *Crotalus cerastes*, *Crotalus helleri,* and *Crotalus horridus* envenomations (Bosak et al., 2014; Bush and Siedenburg, 1999; Clark et al., 1997; Madey et al., 2013).

The actual venom dose delivered with the bite to our patient is indeterminable, but since venom was injected via a single fang puncture it would be reasonable to assume a maximum venom dose was not delivered with the bite. The less-than-fully injected venom volume was likely responsible for the reduced severity and duration of envenomation symptoms observed. Importantly, snake venoms do not contain a single homogeneous toxin and the pharmacokinetics of individual myo- and neurotoxins in *C. o. concolor* venom are not known. As such, it is possible that the short duration of myo-neurological symptoms observed in our patient was related to dose-dependent pharmacokinetics of a responsible toxin, or pharmacokinetic metabolic actions on the responsible venom toxin(s). Although our patient's myo-neurological symptoms were of short duration, it is well documented that the duration of neurotoxic effects following envenomation is highly variable (Ranawaka et al., 2013).

Myokymia has been a reported symptom following envenomation by *C. o. concolor* and other species of North American rattlesnakes (Brick et al., 1987; LoVecchio et al., 2005; Vohra et al. 2008). In our patient, the periodic episodes of tetanic-like, carpopedal spasms, separated many minutes apart, appeared to be distinctly different than myokymia or fasciculations, which typically appear as sustained wave-like movements that typically involve muscle groups near the site of envenomation on the bitten extremity, or facial muscles, and can lead to respiratory compromise (LoVecchio et al., 2005; Vohra et al., 2008). Our patient did not exhibit these sustained wave-like undulations as observed clinically.

Neurological symptoms following *C. o. concolor* envenomation have been anecdotally reported to have occurred rapidly, and involved facial numbness that radiated down the arm, and the patient having complications with maintaining balance (Mackessy et al., 2003). Similar symptoms of persistent paresthesia, weakness, and distal extremity numbness have also been reported following *Crotalus cerastes* envenomation (Bosak et al., 2014). Our patient experienced generalized paresthesia of significant duration and breathing difficulties, and his generalized weakness persisted for days following the bite. These symptoms are consistent with the possibility that in our patient they were the result of a venom-induced effect.

Hematological complications were not observed in the patient presented here. However, cases of severe rattlesnake envenomation with significant neurological effects, and an absence of hematological effects following *Crotalus cerastes* envenomation, or only minimal hematological effects, have been reported (Bosak et al., 2014, Bush and Siedelburg, 1999). In the limited number of cases of *C. o. concolor* envenomation reported, coagulopathy was not always evident or reported (LoVecchio et al., 2005; Mackessy et al., 2003). As such, the absence of hematological effects in our patient does not exclude the fact that some degree of envenomation occurred.

Local wound complications in our patient were modest with slight ecchymosis, swelling, pain, and skin sloughing, and were not unlike those reported following other reported cases of rattlesnake envenomation. Quantitation of serum creatine kinase (CK) is a routinely used clinical and laboratory marker for assessing tissue damage and myonecrosis (Mebs et al., 1983). Our patient's elevated CK value (3394 U/L) reported at 22 hrs post envenomation was likely the result of local tissue/muscle damage at the envenomation site on the thumb. Similar elevation of CK has been reported following *C. o. concolor* envenomation, and in the absence of coagulopathic complications (Lovecchio et al., 2005). Thus, these local tissue damage effects were venom-induced effects in our patient.

Medications taken by patients can potentially influence the effects of snake envenomation (Ostapenko et al., 2001; Schulte et al., 2018). Our patient was using, as prescribed, several medications (atenolol, rizatriptan, and amitriptyline for migraine suppression), and these could potentially exhibit a few adverse effects similar to the symptoms observed following the bite. Although blurred vision, numbness, chest tightness, paresthesia, and weakness may occur with the use of any of these medications (U.S. Food & Drug Administration), the patient reported having no adverse effects to any of these medications prior to the bite. Potential interactions of these medications with venom components, which could result in the causality of any the reported patient's symptoms cannot be ruled out completely, but would seem unlikely.

The venom of *C. o. concolor* has been reported to contain PLA_2-based ß neurotoxin (concolor toxin), and nonenzymatic peptide myotoxins (Bieber et al., 1987; Mackessy et al., 2003; Pool and Bieber, 9181). The case reported here resulted from the bite of a wild-caught captive specimen, and provided an unusual opportunity to determine if venom components and toxins fractionated via high pressure liquid chromatography were present in sufficient quantities to potentially induce the myo- and neurological effects observed in our patient.

Enzyme analysis of the *C. o. concolor* venom sample revealed that six enzymes common to rattlesnake venoms were present (Table 1); however, their levels varied significantly from averaged values based on 22 taxa of rattlesnakes (Mackessy, 2008).

Notably, snake venom metalloproteinase activity (SVMP; azocasein metalloproteinase) was barely detectable, and the presence of only trace amounts of this common rattlesnake venom component is likely responsible for the lack of significant levels of hemorrhage, rhabdomyolysis and inflammation. These very low levels of SVMPs are characteristic of type II venoms, including that of *C. o. concolor* (Mackessy, 2010). Thrombin-like and kallikrein-like serine proteinase activities in the venom were quite high, and thrombin-like activity was nearly twice the average value of many rattlesnake venoms. Because of these high levels of activity, coagulopathies including hypofibrinogenemia would have been expected; however, lab blood panels did not indicate that any form of coagulopathy had occurred. Phospholipase A_2 levels were moderate but not noteworthy compared to other species; PLA_2 activity is sometimes associated with severe inflammation, myotoxicity and occasionally renal damage/failure. The lack of these symptoms indicates that this acidic PLA_2 was not particularly toxic, consistent with similar enzymatic PLA_2s from other species.

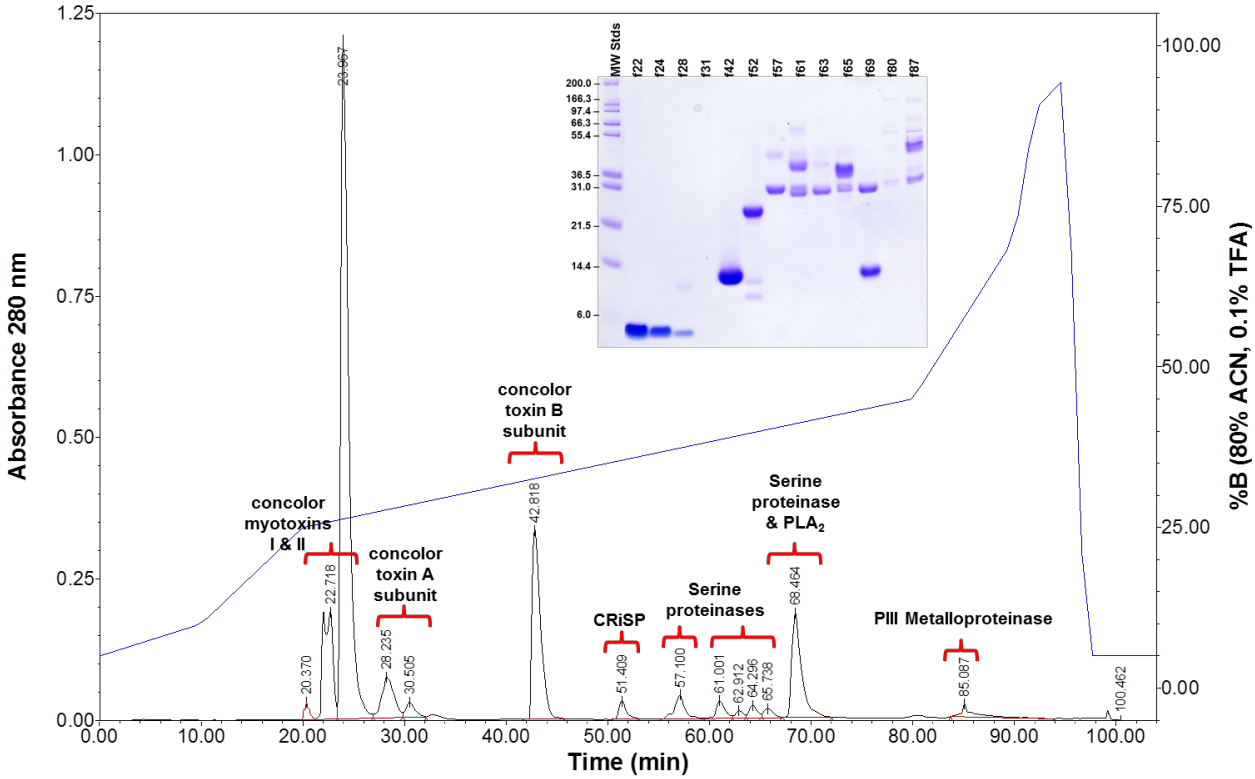
Table 1. Assays of *Crotalus o. concolor* venom for enzyme activities common to rattlesnake venoms. Activity levels in the offending venom relative to averages of 22 taxa of rattlesnakes (Mackessy, 2008) are also indicated.

Enzyme Assayed	**Specific Activity**	**Relative Act.**
Phospholipase A_2 (nmol product/min/mg)	25.38	↓
Azocasein metalloproteinase (Abs 342nm/min/mg)	0.01	↓↓
Kallikrein-like (nmol product/min/mg)	970.87	↑↑
Thrombin-like (nmol product/min/mg)	1388.80	↑↑
Phosphodiesterase (Abs 400nm/min/mg)	0.97	↑
L-amino acid oxidase (nmol product/min/mg)	9.65	↓

↓, venom lower than average; ↑, venom higher than average

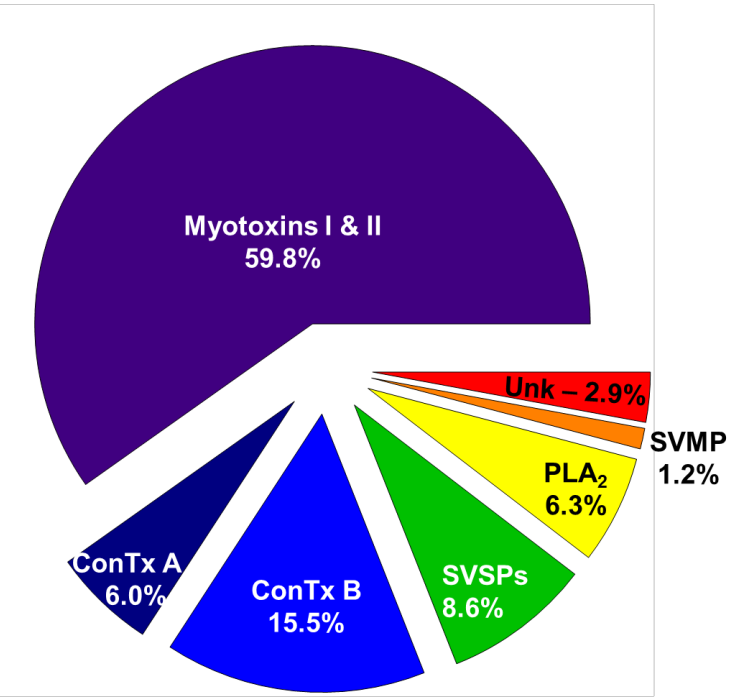
RP-HPLC analysis of the offending snake's venom (Fig. 4) indicated the presence of myotoxins I & II (Bieber et al., 1987), small peptide components common to the venoms of numerous species of rattlesnakes. These myotoxins show potent activity in mammals, causing hyperextension of limbs in mouse models (Ownby et al., 1988). In humans, they may be responsible for fasciculations [possibly muscle weakness, both acute and prolonged] (Ranawaka et al., 2013). The myotoxin content of this venom was extremely high and comprised more than 59% of the total venom proteins (Fig. 5). This venom also contained concolor toxin, a heterodimeric presynaptic neurotoxin with very high sequence identity to Mojave toxin (*Crotalus scutulatus*) and crotoxin (*Crotalus durissus terrificus*); concolor toxin made up more than 21% of the venom total protein content (Figs. 4, 5). The combined actions of these two protein families, which comprised >80% of venom proteins, are likely responsible for the rapid paraesthesias and potentially contributed to the other tetanic-like symptoms observed in the patient.

Fig 4. RP-HPLC chromatogram of *C. o. concolor* venom, 1.6 mg in 200 µL PBS. Identification of peaks are based on SDS-PAGE and enzyme activity assays. Inset: reducing SDS-PAGE of indicated HPLC fractions. CRiSP, cysteine-rich secretory protein.



Serine proteinases are common components of viper venoms, and they accounted for ~8.6% of total venom proteins in the offending *C. o. concolor* in this case (Figs. 4, 5, Table 1). Given their relative abundance and high activity levels in this venom, it is surprising that coagulopathy-related symptoms more pronounced than the slightly elevated D-dimer did not develop. Several other proteins, including an acidic PLA_2 (6.3%) and several unidentified proteins (2.9%), were observed following HPLC and SDS-PAGE, but it is unlikely that they contributed significantly to observed symptoms.

Fig 5. Protein family composition of *Crotalus oreganus concolor* venom. Pie chart represents the relative abundance of proteins from different toxin families in the venom of the offending snake. ConTx A, concolor toxin subunit A; ConTx B, concolor toxin subunit B; PLA_2, phospholipase A_2; SVMP, snake venom metalloproteinase PIII; SVSPs, snake venom serine proteinases; UNK, unidentified proteins.



In conclusion, the presented case revealed that some of the observed symptoms, with respect to both myo-neurological and hematological symptoms, and local tissue effects, were not unlike some of the symptoms in other reported cases of *C. o. concolor* envenomation. The venom profile of the offending snake showed a high myotoxin content, and in this case suggests its potential contribution toward some of the venom-induced myo-neurological symptoms. The case reported here is an interesting academic case in that certain symptoms, similar to previously reported *C. o. concolor* cases of envenomation, were integrated with anxiety and stress-induced symptoms. Additional detailed laboratory analyses and patient neurological evaluation would have provided for a more comprehensive assessment and defined delineation for confirming the source(s) of the patient's symptoms. Thus, a diagnostic conundrum was evident, and medical personnel should be cognizant of the potential for confounding symptoms to be observed when confronted with treating venomous snakebite patients.

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Conflicts of Interest

The authors declare no conflicts of interest, and all authors contributed to the manuscript.

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